Appl. No.: 10/707,922
Amdt. Dated: 8/26/2006
Reply to Office action of: 06/19/2006

AMENDMENTS TO THE DRAWINGS:

There are no amendments to the drawings being presented herewith.

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REMARKS/ARGUMENTS

In the specification, the paragraphs [0004], [0009] – [0010], [0012] – [0020], [0026], [0028], and [0030] have been amended to correct minor editorial problems.

Claims 1 – 11 remain in this application. Claims 1 – 2, 4 – 6, 8, and 10 – 11 have been amended to correct minor editorial problems and remove indefinite language. New claims 12 – 15 have been added to claim features of original claims 1 –11 that were in improper claim format.

No new matter has been introduced by these amendments.

The specification was objected to because of informalities, specifically the typographic error "CC/CC converter" instead of "DC/DC converter". By the amendments to the specification presented herewith this typographic error has been corrected. The objection is now moot and Applicant respectfully requests that it be removed.

Claims 1, 2, 8, and 10 were objected to for the typographic error "CC/CC converter" instead of "DC/DC converter". By the amendments to these claims this typographical error has been corrected. The objection is now moot and Applicant respectfully requests that it be removed.

Claims 1, 5, 6, and 10 were objected to for using indefinite language, specifically, "such as". By the amendments to these claims this indefinite language has been removed. The objection is now moot and Applicant respectfully requests that it be removed.

Claims 1, 3, 4, 7, 8, and 10 were rejected under 35 U.S.C. 103(a) as being unpatentable over Gronbach (2003/0155814) and Maeda (6,340,848). Specifically, the Examiner states:

> Gronbach teaches a vehicle with two networks at different voltage levels (42V and 14V), where each network can feed the other via a bi-directional DC-DC converter (22). He also teaches several equal shunted DC/DC converters (20, 22) connecting the first and second networks connected to a common point. Both networks are fed via a battery (12 and 24) and one is connected to a generator (10). He also teaches loads not being able to be fully supported via one source, so converters, and the other network battery, help to provide support to the one network by supplying the extra power needed to supply to the loads ([0010]). He also teaches a control unit which controls the converters output

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> to each load (last of [0012]). It would be obvious to communicate between the control unit and converters via a communications bus. Gronbach fails to teach having each converter having its own set of loads nor does he teach protection means in some of the loads of each set. Maeda teaches a power distribution system in a vehicle comprising sets of 14V loads (normal load) and 42V loads (large capacity load) in different parts of the vehicle each connected to a distribution box containing a DC/DC converter corresponding to each set of loads. He also teaches fuses (31f, 31d, 33f, 33d, 35d, 35f) protecting the all loads in each set (Fig. 2). It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate a plurality of DC/DC converters assigned to particular sets of loads to minimize the amount of wires running through the system (Maeda – Col. 5, lines 34 –42) and to have more accuracy with different sets of loads. It also would have been obvious to one of ordinary skill I the art at the time of the invention to incorporate fuses into the load side of the converters to protect the loads from overcurrent or overvoltage.

Applicant respectfully traverses this rejection. The key to Applicants' invention is providing an apparatus and method of providing dual voltage electrical systems in vehicles with power at both voltage levels through the utilization of more than two DC/DC converters where at least two of said DC/DC converters are two way converters. Furthermore, the claimed invention provides for the ability of either voltage level system to provide voltage to the other. Applicants' invention also teaches the critical feature of using a high speed bus to connect the plurality of DC/DC converters and a control unit to provide for the ability of protecting and providing necessary electrical flow during transient changes to the load requirements of the vehicle. In addition the ability of the loads to be protected by fuses even during an electrical flow interruption by one or more of the DC/DC converters is disclosed.

A fair reading of the Gronbach reference discloses the use of one or two, one-way DC/DC converters to allow a higher voltage and a lower voltage dual system in a vehicle to be charged by an outside power source which is of a voltage level different from both of the voltage levels of the onboard dual voltage system (see for example, paragraph [0003]). This reference further discloses the use of one step-down DC/DC converter from

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the outside reference voltage to the lower voltage level onboard and one step-up DC/DC converter to convert the reference voltage that is higher than the 14V level up to the higher 42V level of the onboard system (see for example paragraph [0004]). The whole point of the reference teaching is to allow an outside voltage source which has a voltage value lying between the upper and the lower voltages of the onboard system to charge both onboard systems as necessary with a simplified power point and a inexpensive jumper cable as well as to allow the outside power source to start the vehicle if necessary (see for example paragraphs [0005] and [0017]). The two DC/DC converters do not cooperate with one another only with the outside power source to allow the outside power source to charge either or both voltage level batteries or operate either or both of the voltage level loads (see for example paragraph [0012]). Figure 2 of the reference teaches the use of a polar relay to prevent direct connection of the outside reference voltage supply and the higher 42V voltage onboard system (see for example paragraph [0014]). Finally, this reference teaches the use of multiphase converters connected in parallel and controlled a clock time-staggered manner to allow the use the same set of DC/DC converters as both step-down and step-up converters (see for example paragraph [0016]). The Gronbach reference does not disclose, teach, or fairly suggest how to use DC/DC converters to allow either the higher voltage level or lower voltage level of the onboard vehicle dual voltage system to charge the other or to power the others loads if necessary. Further, this reference does not disclose, teach, or fairly suggest the use of a high speed CAN or VAN bus. The Gronbach reference also fails to provide the necessary impetus to direct one of ordinary skill in the art to combine the disclosed invention with other references to arrive at Applicant's claimed invention.

A fair reading of the Maeda reference discloses an on-vehicle distribution box and electrical power distribution system having only one voltage level (43V) system onboard, (see for example Col. 3, lines 24 – 36). This system utilizes DC/DC converters to convert the single voltage system to two separate voltages for use with loads having lower voltage than the single 42V system of the vehicle (see for example Col. 3, lines 46 – 58) and all of the converters are step-down converters only (see for example Col. 4, lines 63 – 67). The reference further discloses that each power sector in the vehicle has only one DC/DC step-down converter (see for example Col. 3, lines 46 – 59 and Col. 4, lines 12 – 19)). The disclosure also teaches lower voltage control fuses all being located down

stream from the DC/DC converter making the fuses inoperative and not able to protect their associated loads when the DC/DC converter shuts down to protect itself or the DC/DC converters must be sacrificial to allow the fuses to continue to protect the associated loads (see for example Col. 4, lines 20 – 47 and Col. 6, lines 15 – 23, and Fig. 2). Clearly the Maeda reference does not teach the use of DC/DC converters in a dual voltage source onboard vehicle system but instead the use of single DC/DC step down convert in each electrical sector requiring lower voltage than the single 42V voltage system of a single voltage onboard vehicle system. Further this reference does not teach how to use both step down and step-up DC/DC converters to allow voltage of either a higher level from a lower voltage level on board system or a lower level from a higher voltage level on board system to be interconnected as necessary to maintain both voltage level systems in the vehicle (see for example the single voltage level system of Fig. 2). The Maeda reference also does not provide the necessary impetus to one skilled in the art to modify this single onboard voltage level system to a dual voltage level onboard system and even if it did, which it does not, it does not suggest how to reach Applicant's claimed invention.

Clearly, when viewed in this light the Gronbach reference, Maeda reference, and any combination thereof do not disclose, teach, or fairly suggest the dual voltage electrical supply system utilizing at least three DC/DC converters of which at least two are two way converters capable of providing electrical voltage even during transient changes in the loads and providing fuse protection of the loads of Applicants' present invention.

Claims 2, 9, and 11 were rejected under 35 U.S.C. 103(a) as being unpatentable over Gronbach (2003/0155814) and Maeda (6,340,848) as applied to claims 1 and 10 above, and further in view of Nonaka (JP 08-111932 A). Specifically, the Examiner states:

> Gronbach and Maeda teach a vehicle power distribution system as described above. Gronbach teaches a controller that controls the output of the converters (last of [0012]). Maeda teaches each set of 42V loads each being associated with a DC/DC converter. Gronbach and Maeda fail to explicitly teach detecting the current required by the loads. Nonaka teaches detecting the power requirement of a load. It would have been obvious to one of ordinary skill in the

art at the time of the invention to, via some point in the circuit, detect the current required by each load, so that Gronbach's controller will know what voltage to output from the converters to properly feed the loads.

Applicant respectfully traverses this rejection. The key to Applicants' invention, as mentioned above, is providing an apparatus and method of providing dual voltage electrical systems in vehicles with power at both voltage levels through the utilization of more than two DC/DC converters where at least two of said DC/DC converters are two way converters. Furthermore, the claimed invention provides for the ability of either voltage level system to provide voltage to the other. Applicants' invention also teaches the critical feature of using a high speed bus to connect the plurality of DC/DC converters and a control unit to provide for the ability of protecting and providing necessary electrical flow during transient changes to the load requirements of the vehicle. In addition the ability of the loads to be protected by fuses even during an electrical flow interruption by one or more of the DC/DC converters is disclosed.

A fair reading of the Gronbach reference, as mentioned above, discloses the use of one or two, one-way DC/DC converters to allow a higher voltage and a lower voltage dual system in a vehicle to be charged by an outside power source which is of a voltage level different from both of the voltage levels of the onboard dual voltage system (see for example, paragraph [0003]). This reference further discloses the use of one step-down DC/DC converter from the outside reference voltage to the lower voltage level onboard and one step-up DC/DC converter to convert the reference voltage that is higher than the 14V level up to the higher 42V level of the onboard system (see for example paragraph [0004]). The whole point of the reference teaching is to allow an outside voltage source which has a voltage value lying between the upper and the lower voltages of the onboard system to charge both onboard systems as necessary with a simplified power point and a inexpensive jumper cable as well as to allow the outside power source to start the vehicle if necessary (see for example paragraphs [0005] and [0017]). The two DC/DC converters do not cooperate with one another only with the outside power source to allow the outside power source to charge either or both voltage level batteries or operate either or both of the voltage level loads (see for example paragraph [0012]). Figure 2 of the reference teaches the use of a polar relay to prevent direct connection of the outside reference voltage supply and the higher 42V voltage onboard system (see for example

paragraph [0014]). Finally, this reference teaches the use of multiphase converters connected in parallel and controlled a clock time-staggered manner to allow the use the same set of DC/DC converters as both step-down and step-up converters (see for example paragraph [0016]). The Gronbach reference does not disclose, teach, or fairly suggest how to use DC/DC converters to allow either the higher voltage level or lower voltage level of the onboard vehicle dual voltage system to charge the other or to power the others loads if necessary. Further, this reference does not disclose, teach, or fairly suggest the use of a high speed CAN or VAN bus. The Gronbach reference also fails to provide the necessary impetus to direct one of ordinary skill in the art to combine the disclosed invention with other references to arrive at Applicant's claimed invention.

A fair reading of the Maeda reference, as mentioned above, discloses an on-vehicle distribution box and electrical power distribution system having only one voltage level (43V) system onboard, (see for example Col. 3, lines 24 – 36). This system utilizes DC/DC converters to convert the single voltage system to two separate voltages for use with loads having lower voltage than the single 42V system of the vehicle (see for example Col. 3, lines 46 – 58) and all of the converters are step-down converters only (see for example Col. 4, lines 63 – 67). The reference further discloses that each power sector in the vehicle has only one DC/DC step-down converter (see for example Col. 3, lines 46 – 59 and Col. 4, lines 12 – 19)). The disclosure also teaches lower voltage control fuses all being located down stream from the DC/DC converter making the fuses inoperative and not able to protect their associated loads when the DC/DC converter shuts down to protect itself or the DC/DC converters must be sacrificial to allow the fuses to continue to protect the associated loads (see for example Col. 4, lines 20 – 47 and Col. 6, lines 15 – 23, and Fig. 2). Clearly the Maeda reference does not teach the use of DC/DC converters in a dual voltage source onboard vehicle system but instead the use of single DC/DC step down convert in each electrical sector requiring lower voltage than the single 42V voltage system of a single voltage onboard vehicle system. Further this reference does not teach how to use both step down and step-up DC/DC converters to allow voltage of either a higher level from a lower voltage level on board system or a lower level from a higher voltage level on board system to be interconnected as necessary to maintain both voltage level systems in the vehicle (see for example the single voltage level system of Fig. 2). The Maeda reference also does not provide the necessary impetus

to one skilled in the art to modify this single onboard voltage level system to a dual voltage level onboard system and even if it did, which it does not, it does not suggest how to reach Applicant's claimed invention.

A fair reading of Nonaka reference English language abstract discloses the use of a DC/DC converter to change the output voltage of a single voltage level power supply. It teaches the use of a microcomputer to switch the DC/DC converter state (see whole English translation of abstract). There is no disclosure, teaching, or fair suggestion of using the disclosed battery charger to control dual level voltage systems in vehicles, or how to use more than one DC/DC converter, or the use of multi-stage converts in parallel. Quite simply this reference does not teach one skilled in the art anything about dual voltage systems in vehicles or how to adapt it to such a use. Furthermore, nowhere is there the necessary impetus to suggest to one of ordinary skill in the art to combine it with the Gronbach and/or the Maeda references to reach Applicants' claimed invention.

Clearly, when viewed in this light the Gronbach reference, Maeda reference, Nonaka reference, and any combination thereof do not disclose, teach, or fairly suggest the dual voltage electrical supply system utilizing at least three DC/DC converters of which at least two are two way converters capable of providing electrical voltage even during transient changes in the loads and providing fuse protection of the loads of Applicants' present invention.

Claims 5 and 6 were rejected under 35 U.S.C. 103(a) as being unpatentable over Gronbach (2003/0155814) and Maeda (6,340,848) as applied to claim 1 above, and further in view of Tamai et al. (2002/0190690). Specifically, the Examiner states:

> Gronbach and Maeda teach a vehicle power distribution system as described above. They fail to teach the use of fuses and switches as protecting means for the loads. Tamai teaches the use of both fuses and controlled switches (22—25) as protection means (Fig. 1). It would have been obvious to one of ordinary skill in the art at the time of the invention to implement fuses and switches into some of the load circuits to include extra protection against overcurrent and overvoltage.

Applicant respectfully traverses this rejection. The key to Applicants' invention, as mentioned above, is providing an apparatus and method of providing dual voltage electrical systems in vehicles with power at both voltage levels through the utilization of

more than two DC/DC converters where at least two of said DC/DC converters are two way converters. Furthermore, the claimed invention provides for the ability of either voltage level system to provide voltage to the other. Applicants' invention also teaches the critical feature of using a high speed bus to connect the plurality of DC/DC converters and a control unit to provide for the ability of protecting and providing necessary electrical flow during transient changes to the load requirements of the vehicle. In addition the ability of the loads to be protected by fuses even during an electrical flow interruption by one or more of the DC/DC converters is disclosed.

A fair reading of the Gronbach reference, as mentioned above, discloses the use of one or two, one-way DC/DC converters to allow a higher voltage and a lower voltage dual system in a vehicle to be charged by an outside power source which is of a voltage level different from both of the voltage levels of the onboard dual voltage system (see for example, paragraph [0003]). This reference further discloses the use of one step-down DC/DC converter from the outside reference voltage to the lower voltage level onboard and one step-up DC/DC converter to convert the reference voltage that is higher than the 14V level up to the higher 42V level of the onboard system (see for example paragraph [0004]). The whole point of the reference teaching is to allow an outside voltage source which has a voltage value lying between the upper and the lower voltages of the onboard system to charge both onboard systems as necessary with a simplified power point and a inexpensive jumper cable as well as to allow the outside power source to start the vehicle if necessary (see for example paragraphs [0005] and [0017]). The two DC/DC converters do not cooperate with one another only with the outside power source to allow the outside power source to charge either or both voltage level batteries or operate either or both of the voltage level loads (see for example paragraph [0012]). Figure 2 of the reference teaches the use of a polar relay to prevent direct connection of the outside reference voltage supply and the higher 42V voltage onboard system (see for example paragraph [0014]). Finally, this reference teaches the use of multiphase converters connected in parallel and controlled a clock time-staggered manner to allow the use the same set of DC/DC converters as both step-down and step-up converters (see for example paragraph [0016]). The Gronbach reference does not disclose, teach, or fairly suggest how to use DC/DC converters to allow either the higher voltage level or lower voltage level of the onboard vehicle dual voltage system to charge the other or to power the

others loads if necessary. Further, this reference does not disclose, teach, or fairly suggest the use of a high speed CAN or VAN bus. The Gronbach reference also fails to provide the necessary impetus to direct one of ordinary skill in the art to combine the disclosed invention with other references to arrive at Applicant's claimed invention.

A fair reading of the Maeda reference, as mentioned above, discloses an on-vehicle distribution box and electrical power distribution system having only one voltage level (43V) system onboard, (see for example Col. 3, lines 24 – 36). This system utilizes DC/DC converters to convert the single voltage system to two separate voltages for use with loads having lower voltage than the single 42V system of the vehicle (see for example Col. 3, lines 46 – 58) and all of the converters are step-down converters only (see for example Col. 4, lines 63 – 67). The reference further discloses that each power sector in the vehicle has only one DC/DC step-down converter (see for example Col. 3, lines 46 – 59 and Col. 4, lines 12 – 19)). The disclosure also teaches lower voltage control fuses all being located down stream from the DC/DC converter making the fuses inoperative and not able to protect their associated loads when the DC/DC converter shuts down to protect itself or the DC/DC converters must be sacrificial to allow the fuses to continue to protect the associated loads (see for example Col. 4, lines 20 – 47 and Col. 6, lines 15 – 23, and Fig. 2). Clearly the Maeda reference does not teach the use of DC/DC converters in a dual voltage source onboard vehicle system but instead the use of single DC/DC step down convert in each electrical sector requiring lower voltage than the single 42V voltage system of a single voltage onboard vehicle system. Further this reference does not teach how to use both step down and step-up DC/DC converters to allow voltage of either a higher level from a lower voltage level on board system or a lower level from a higher voltage level on board system to be interconnected as necessary to maintain both voltage level systems in the vehicle (see for example the single voltage level system of Fig. 2). The Maeda reference also does not provide the necessary impetus to one skilled in the art to modify this single onboard voltage level system to a dual voltage level onboard system and even if it did, which it does not, it does not suggest how to reach Applicant's claimed invention.

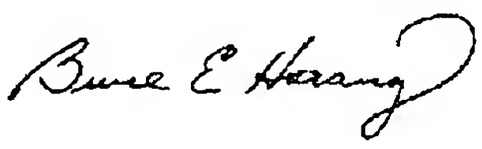
A fair reading of Tamai et al. reference discloses a power source system for use in powering a hybrid vehicle that uses both internal combustion power and electrical power at various times to power the vehicle's drive train (see for example paragraph [0010]).

The disclosure also teaches an apparatus to charge batteries of two different voltage levels when they are low using a one-way DC/DC step-down converter. While a dual voltage system is disclosed it provides for voltage to move only from the higher voltage (42V) side to the lower voltage (14V) side of the dual voltage system using a single DC/DC step-down converter (see for example paragraphs [0011], [0049], and [0050]). The single DC/DC step-down converter is a one-way converter (see for example paragraphs [0040] and [0041]). This reference does not teach the use of multiple DC/DC converters of any type, and teaches nothing about the use of multi-stage and/or step-up converters. The Tamai et al. reference lacks any necessary impetus to direct one skilled in the art to combine it with any other reference for any purpose, certainly not with the Gronbach and/or Maeda reference to create a dual voltage onboard electrical system in a vehicle.

Clearly, when viewed in this light the Gronbach reference, Maeda reference, Tamai et al. reference, and any combination thereof do not disclose, teach, or fairly suggest the dual voltage electrical supply system utilizing at least three DC/DC converters of which at least two are two way converters capable of providing electrical voltage even during transient changes in the loads and providing fuse protection of the loads of Applicants' present invention.

In view of the remarks herein, and the amendments hereto, it is submitted that this application is in condition for allowance, and such action and issuance of a timely Notice of Allowance is respectfully solicited.

Respectfully submitted,



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